AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

Claims 1-12 (canceled).

Claim 13 (new): An engine control system comprising:

an ion current measuring unit arranged to measure a negative ion current in a combustion chamber of an engine;

a crank-angle measuring unit arranged to measure an engine crank angle; and

a controller comprising:

means for determining a first crank angle based on the negative ion current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the first crank angle being a crank angle corresponding to a rising point of the negative ion current at or above a first specified value on a negative ion current curve indicative of variations in negative ion current relative to crank angles;

means for determining a second crank angle based on the negative ion current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the second crank angle being a crank angle corresponding to a peak point of the negative ion current on the negative ion current curve;

means for calculating a substantial middle point between the first crank angle and the second crank angle as a third crank angle corresponding to a combustion center of gravity; and

means for controlling an engine ignition timing so that the third crank angle approximates a desired target crank angle.

Claim 14 (new): The engine control system according to claim 13, wherein the desired target crank angle is not changed according to engine load conditions.

Claim 15 (new): The engine control system according to claim 13, wherein the desired crank angle corresponds to Maximum Best Timing.

Claim 16 (new): The engine control system according to claim 13, wherein the desired crank angle corresponds to about 1° to about 5° before top dead center of the crank angle.

Claim 17 (new): The engine control system according to claim 13, wherein the desired target crank angle is set to a predetermined crank angle delayed behind Maximum Best Timing.

Claim 18 (new): A vehicle comprising:

the engine control system according to claim 13.

Claim 19 (new): An engine control system comprising:

an ion current measuring unit arranged to measure a negative ion current in a combustion chamber of an engine;

a crank-angle measuring unit arranged to measure an engine crank angle; and

a controller comprising:

means for determining a first crank angle based on the negative ion current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the first crank angle being a crank angle corresponding to a rising point of the negative ion current at or above a first specified value on a negative ion current curve indicative of variations in negative ion current relative to crank angles;

means for determining a second crank angle based on the negative ion

current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the second crank angle being a crank angle corresponding to a peak point of the negative ion current on the negative ion current curve;

means for calculating a substantial middle point between the first crank angle and the second crank angle as a third crank angle corresponding to a combustion center of gravity;

means for calculating a variation rate of the third crank angle; and

means for controlling an exhaust gas recirculation rate of the engine so that the exhaust gas recirculation rate decreases when the variation rate increases.

Claim 20 (new): An engine control system comprising:

an ion current measuring unit arranged to measure a negative ion current in a combustion chamber of an engine, the engine having an intake valve and an exhaust valve;

a crank-angle measuring unit arranged to measure an engine crank angle; and

a controller comprising:

means for determining a first crank angle based on the negative ion current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the first crank angle being a crank angle corresponding to a rising point of the negative ion current at or above a first specified value on a negative ion current curve indicative of variations in negative ion current relative to crank angles;

means for determining a second crank angle based on the negative ion current measured by the ion current measuring unit and the engine crank angle measured by the crank-angle measuring unit, the second crank angle being a crank angle corresponding to a peak point of the negative ion current on the negative ion current curve;

means for calculating a substantial middle point between the first crank

angle and the second crank angle as a third crank angle corresponding to a combustion center of gravity;

means for calculating a variation rate of the third crank angle;

means for controlling an open-close timing of the intake valve and the exhaust valve so that an overlap period of the intake valve and the exhaust valve decreases as the variation rate increases.

Claim 21 (new): A method for calculating a combustion center of gravity of an engine, the method comprising:

measuring a negative ion current in a combustion chamber of the engine;

determining a first crank angle corresponding to a rising point of the negative ion current at or above a first specified value on a negative ion current curve indicative of variations in negative ion current relative to crank angles;

determining a second crank angle corresponding to a peak point of the negative ion current on the negative ion current curve; and

calculating a substantial middle point between the first crank angle and the second crank angle as a combustion center of gravity.

Claim 22 (new): A method for controlling the operation of an engine, the method comprising:

measuring a negative ion current in a combustion chamber of the engine;

determining a first crank angle corresponding to a rising point of the negative ion current at or above a first specified value on a negative ion current curve indicative of variations in negative ion current relative to crank angles;

determining a second crank angle corresponding to a peak point of the negative ion current on the negative ion current curve;

calculating a substantial middle point between the first crank angle and the second crank angle as a third crank angle corresponding to a combustion center of gravity; and

controlling engine ignition timing so that the third crank angle approximates a desired target crank angle.